

Nanophotonics and Microcavities for Dense WDM Systems

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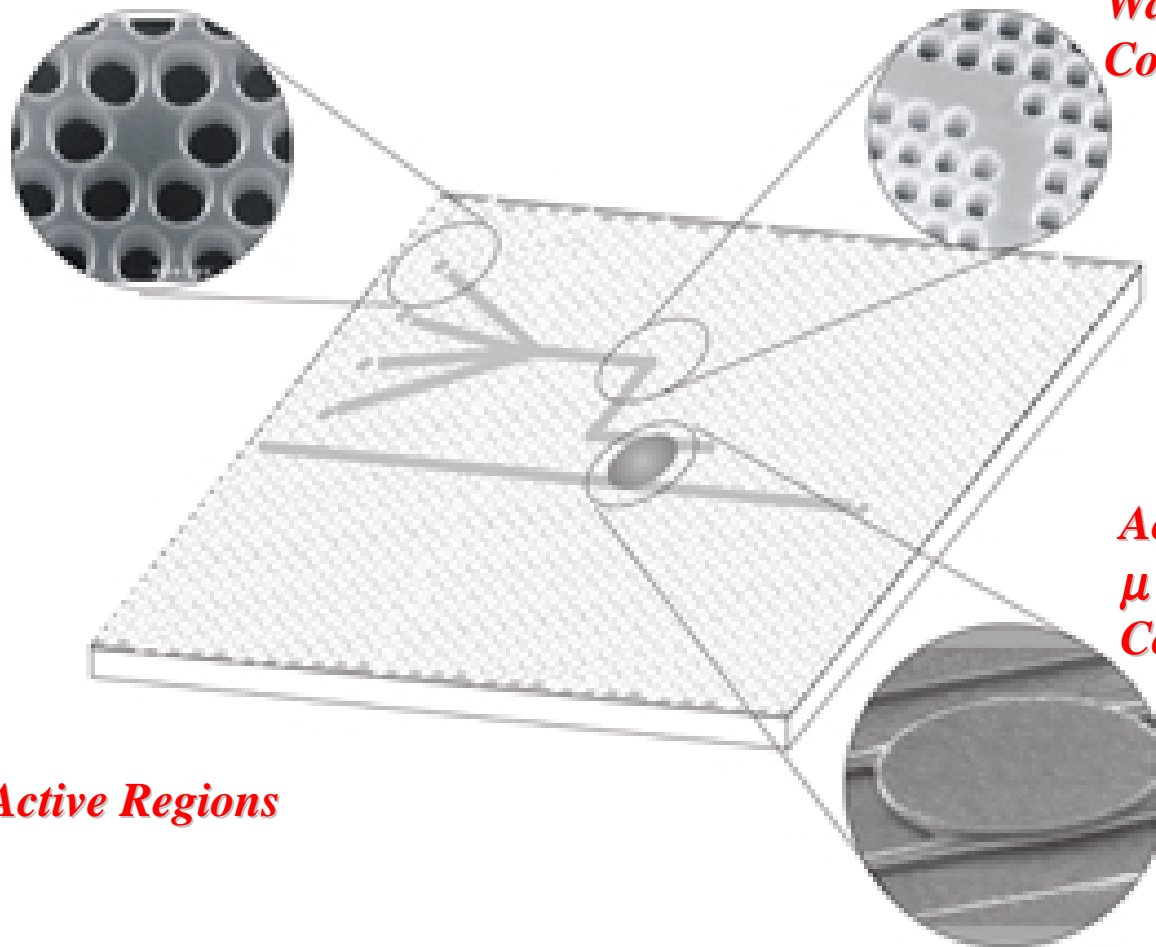
The Photonics Center @ USC

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Integrated Nanophotonic Technology

Photonic Crystal Defect Nanolasers

***Photonic Crystal
Waveguide
Components***



***Active and Passive
 μ resonator
Components***

QW and QD Active Regions

μ Disk and Photonic Crystal Devices for DWDM Systems

- **High Density Integrated Systems**
VLSI Photonic Integrated Circuits
- **Compact, Low Power Components**
Millimeters → Microns
- **Single or Multi-wavelength Resonant Components**
- **New Functionality in Active Components**

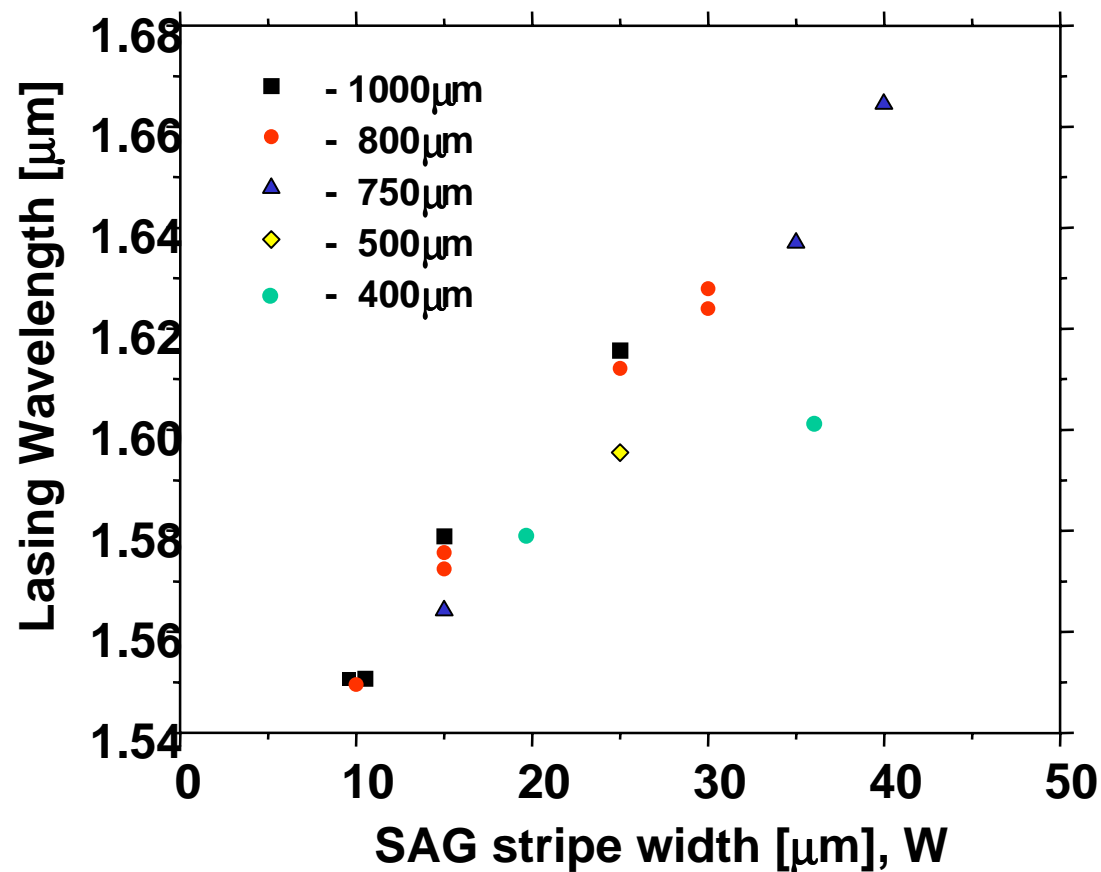
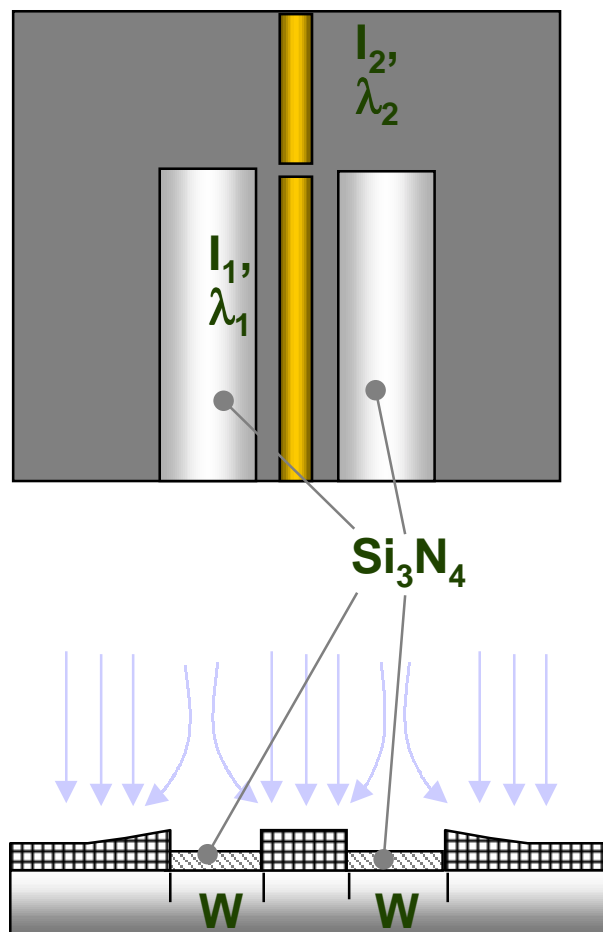
Integrable Nanophotonic Components

- ***DWDM μ -Disk and Nanolasers and Arrays***
- ***Tunable Lasers***
- ***Dispersive, Superprism Propagation***
- ***Low Voltage, High Bit Rate Modulators***
- ***Wavelength Selective Switches***
- ***Narrow Band Tunable Filters and Detectors***
- ***Wavelength Selective Couplers and Splitters***
- ***Chemical and Biological Sensor Elements***
- ***Waveguide to Fiber Couplers***

Nanophotonic Technologies

- ***High Q Resonators***
- ✓ ***Heterogeneous Integration***
- ✓ ***Electron Beam Lithography***
- ✓ ***Highly Asymmetric Dry Etching***
- ✓ ***Selective Area Epitaxy***
- ✓ ***QW and QD Active Regions***

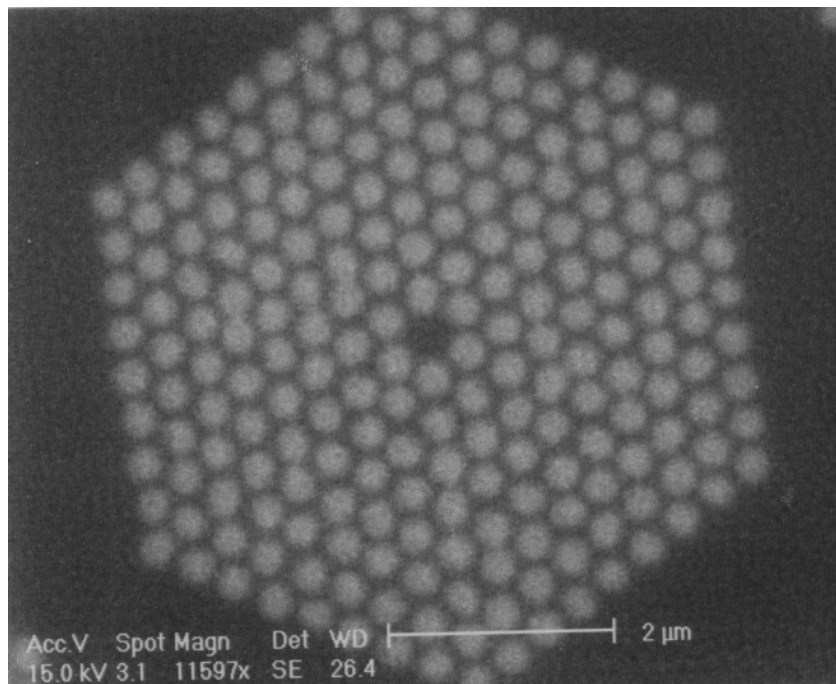
Selectively Grown Active Regions



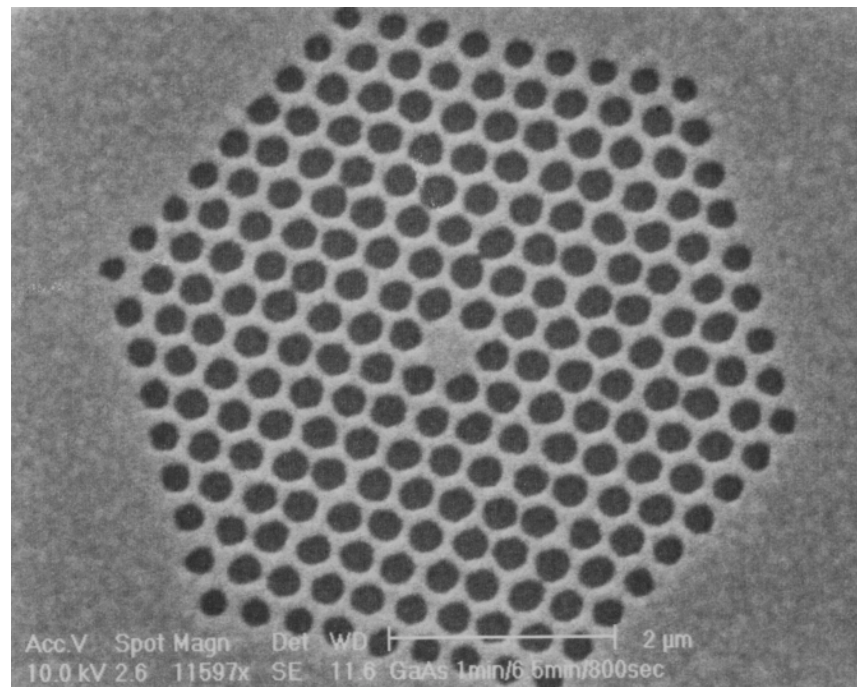
Resonant Cavity Structures

$$r = 135 \text{ nm}$$

$$a = 400 \text{ nm}$$

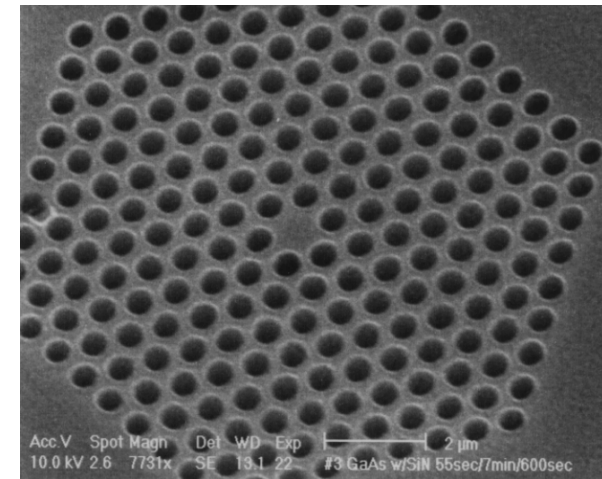
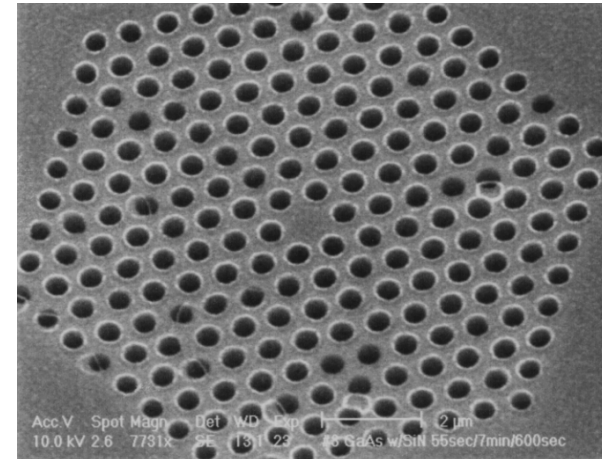
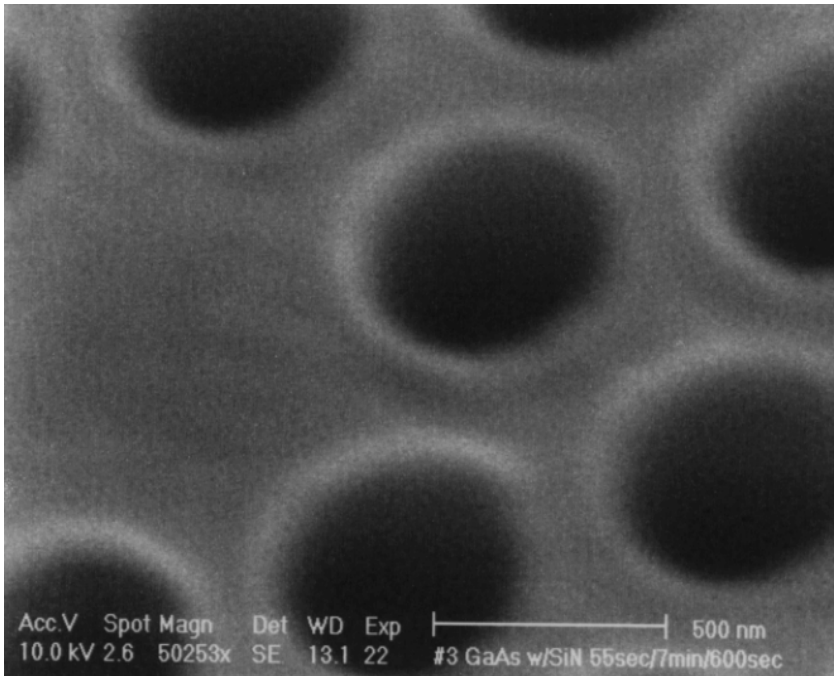


After Lithography

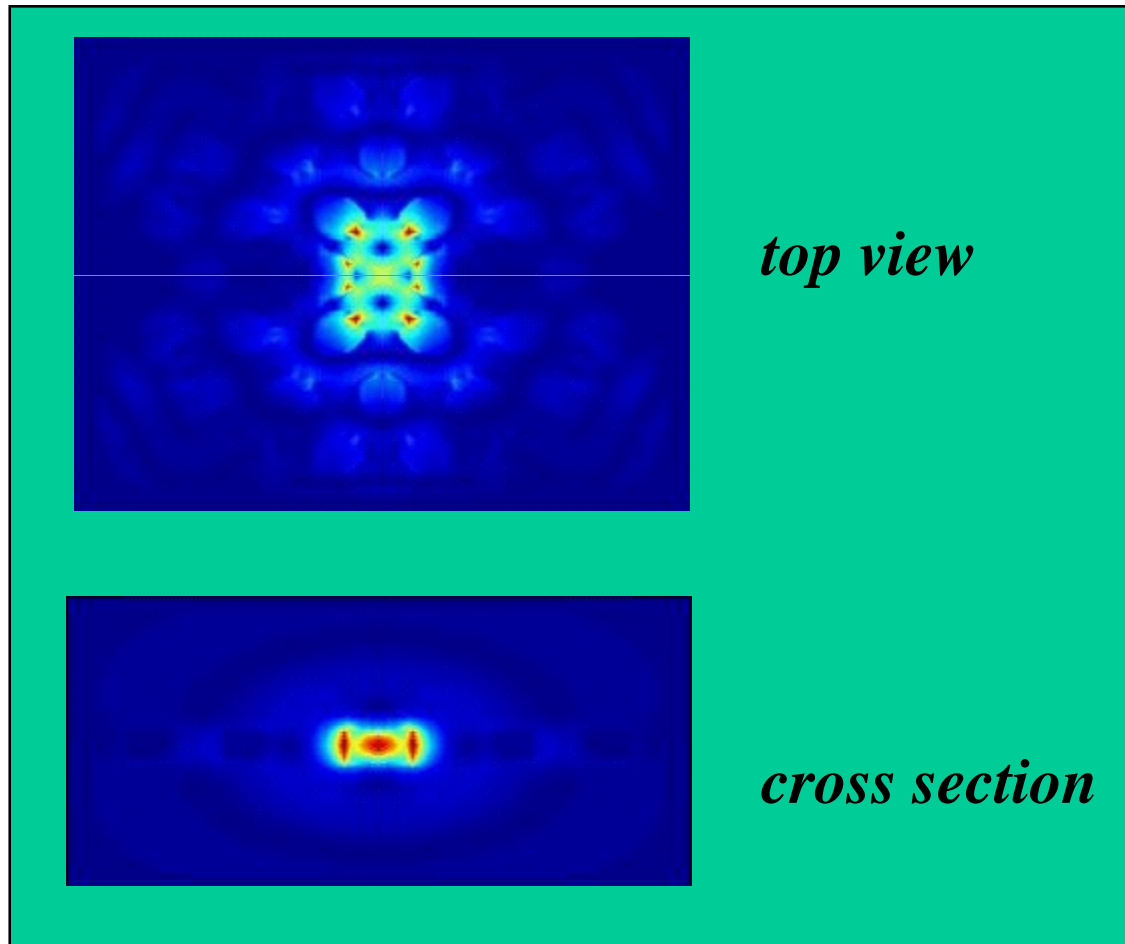


After RIE Etch

Top Views of GaAs PBGs after ECR etch

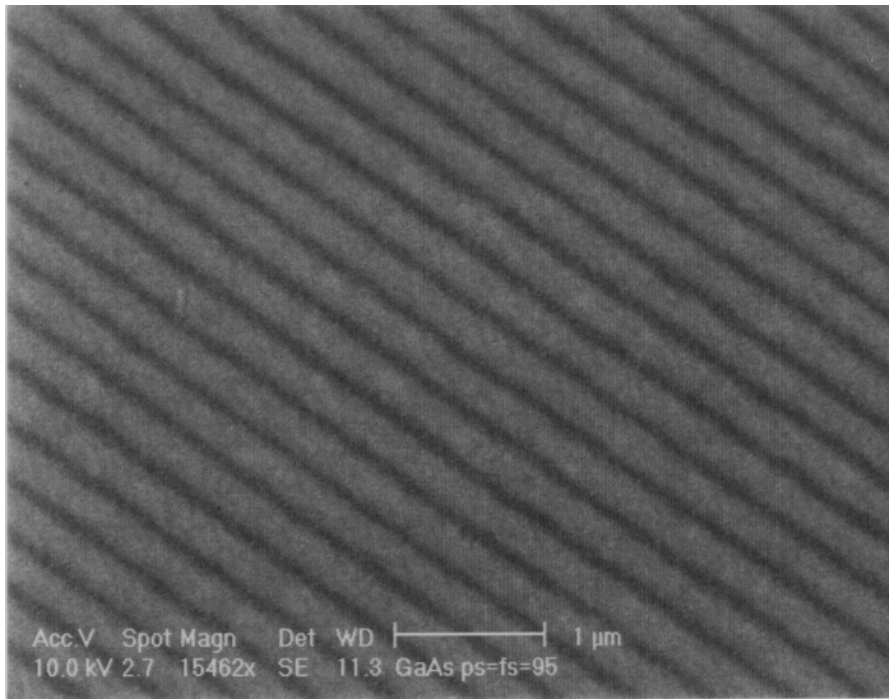


Magnitude of the Electric Field in the Defect Cavity

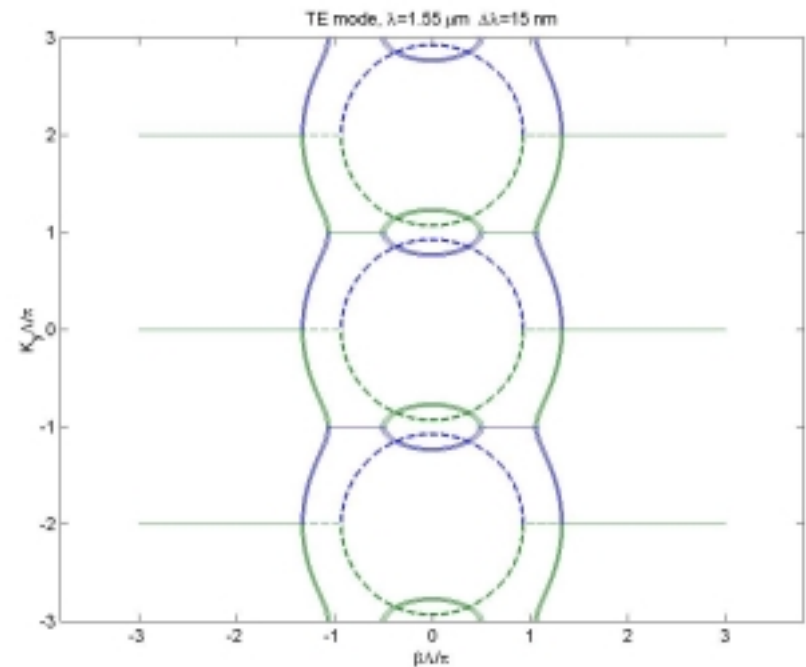


One-Dimensional Lattices

sample after lithography



dispersion surface



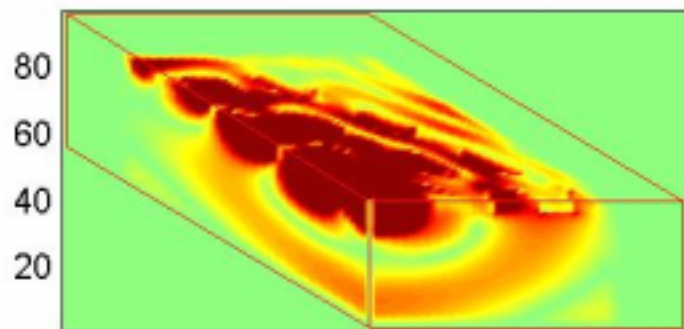
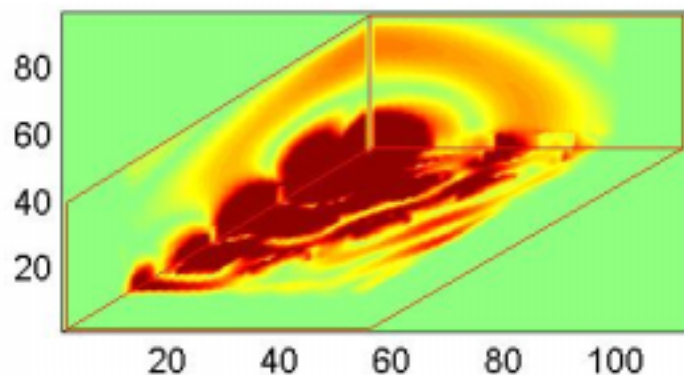
Superprism effect can be used for routing or multiplexing/demultiplexing

$$\vec{v}_g = \nabla_{\vec{k}} \omega(\vec{k})$$

Magnitude of the Electric Field in the Defect Cavity

symmetric cladding

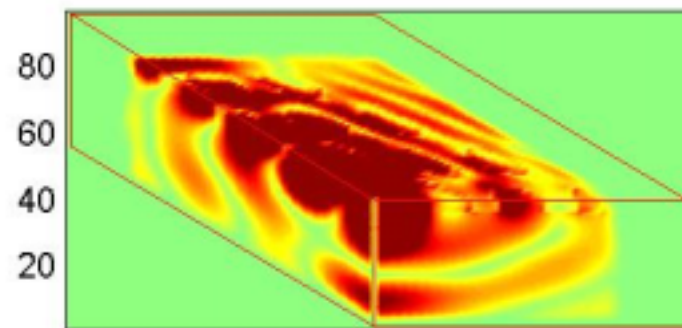
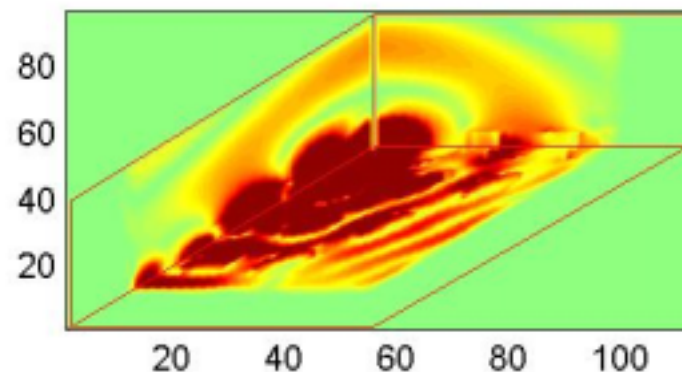
top



bottom

asymmetric cladding

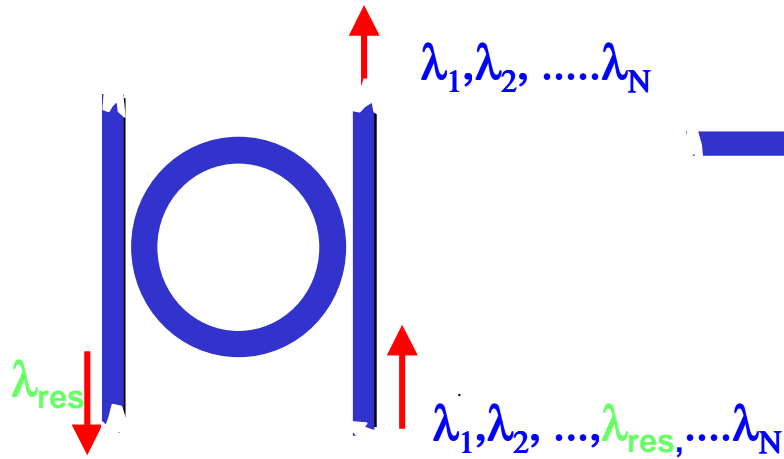
top



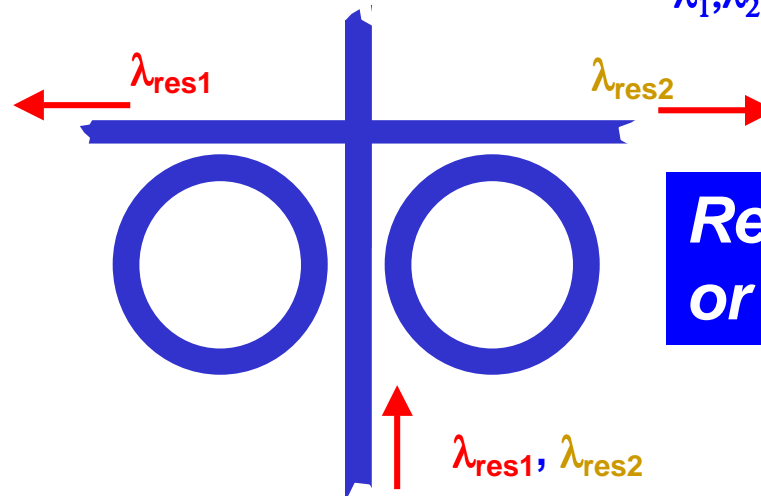
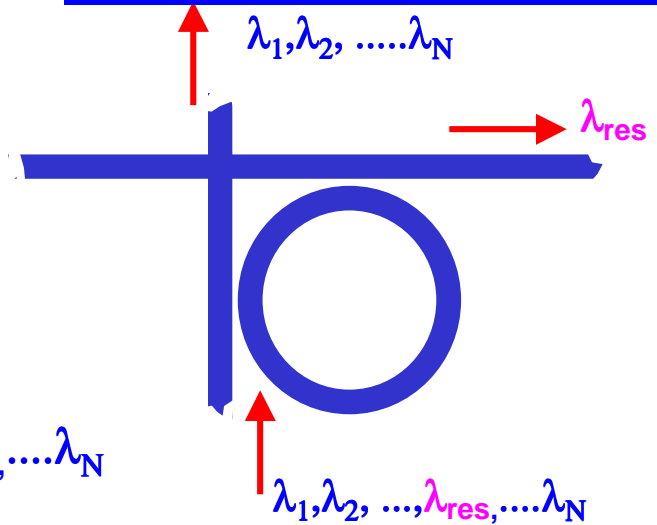
bottom

μ Resonator Structures

Resonant Filter / Switch

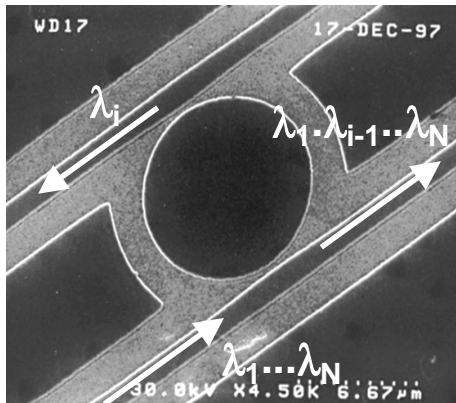


Resonant Y or Splitter



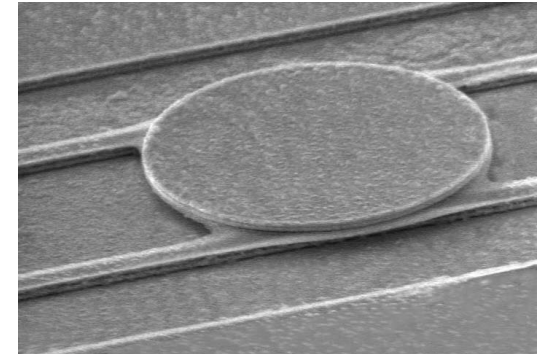
Resonant T or Splitter

Vertical Coupler Fabricated by Heterogeneous Integration



OLD

NEW



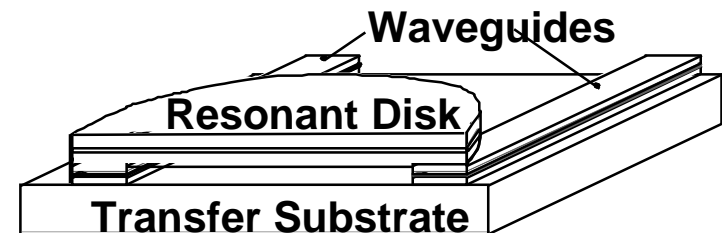
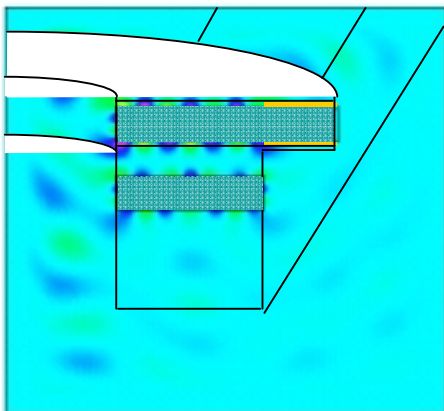
Laterally Coupled Disk

- Air Coupling
- Sub Micron Control

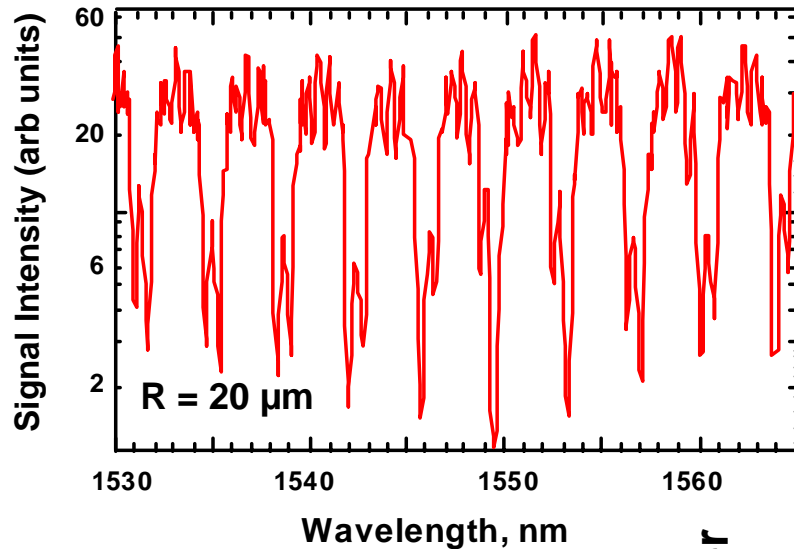
- Add-Drop Filters
- Resonant Detectors
- Integrated Lasers
- Resonant Modulators

Vertically Coupled Disk

- Epi Layer Coupling
- Control Coupling by Epilayer Thickness



μ Disk Resonant Components



← *Passive μ disk coupler*

*Active μ disk
tunable filter / switch* →

